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I. Introduction

1. The main objective of Pakistan's space programme being executed by the national space agency, the Space and Upper Atmosphere Research Commission (SUPARCO), is to promote peaceful exploration and applications of space science and technology in the country. While pursuing that objective, it is quite natural that the space programme would also contribute to building national scientific and technological potential. The principal applications are aimed at bringing about the socio-economic development of society. The focus of the programme is on areas related to satellite communications: satellite remote sensing for natural resources and environmental survey; development of facilities for designing, assembly/fabrication and launching of communication satellites in geostationary orbit and light-weight satellites in near-Earth orbit for various scientific and applications purposes; and study of natural and physical phenomena in the upper atmosphere and space through rocket launchings and other means. Over the past two decades, SUPARCO's space programme has continued to expand in terms of the range of its research, applications and related activities.

II. Satellite technology

2. Pakistan has developed sufficient technological capability to plan, design, build and test satellites for scientific and technological experiments. The aim is to reduce dependence on satellites owned by other countries through development, launching and operation of Pakistan's own satellites. In 1990, SUPARCO designed, fabricated and launched its first satellite, BADR-I, into a low circular orbit, on board a Chinese vehicle, in "piggy-back" mode. Extremely valuable data were gathered on the performance of BADR-I in orbit. The findings from BADR-I provided the basis for the design of the second satellite BADR-B, which has been completed and dispatched to the Russian Federation for a planned launching in 1999 into a low-Earth, 1,000-kilometre, Sun-synchronous orbit on board a Russian launch vehicle. The design life of BADR-B is over two years. The satellite will carry experiments for the monitoring of clouds, land usage, radiation levels, for storage and forward communication, engineering and evaluation of hardware/software in the space environment.

3. Initiated by SUPARCO for domestic communications and television broadcasting from space, the PAKSAT project was cleared by the Federal Cabinet on 16 April 1997 for award to Alcatel Espace of France and a licence in that regard has been issued.

4. Pakistan's involvement in a small multi-mission satellite project within the framework of Asia-Pacific multilateral cooperation in space technology and applications will further facilitate indigenous development of higher-resolution imaging payloads.

5. Development and launching of Earth observation satellites will provide high-resolution data-acquisition capability for better assessment, monitoring and exploitation of natural resources. To support the satellite development programme, Pakistan has established a general-purpose S-band tracking, telemetry and control station at Lahore. The station will be used in the operation of BADR-B and subsequent Pakistan satellites.

III. Development of satellite launch vehicles

6. Starting with the development of small sounding rockets for studies of the upper atmosphere, Pakistan has embarked on the project to design, develop and manufacture rocket motors, leading to the development of satellite launch vehicles capable of putting small satellites into low-Earth orbits of altitudes between 400 and 600 kilometres.

IV. Applications of space science and technology

7. Present-day applications of satellite data are widespread and cover research and operational and commercial activities. Those activities are of interest both in the global contexts and in the regional, national and local context, where Earth observation data are successfully applied in support of a host of different applications in remote sensing and meteorology.

8. Pakistan operates two satellite Earth stations, one at Deh Mandro (since 1974) and the other at Islamabad (since 1987). The two Earth stations provide a 24-hour direct link, through the International Telecommunications Satellite Organization (INTELSAT) system, between Pakistan and other countries of the world. In addition to the terrestrial microwave network linking the various national television stations and centres, Pakistan has leased a transponder on the ASIASAT for telecasting educational and entertainment programmes to viewers in Pakistan and other countries in the region.

9. Pakistan has been pursuing a multidisciplinary satellite remote sensing (SRS) applications programme for resource surveying and mapping and environmental monitoring since 1975. Several research studies using data from various remote sensing satellite systems have been carried out. Increasing use is now being made of geographic information system (GIS) technology in conjunction with SRS data. These studies have covered such diverse disciplines as agriculture, forestry, geography, geology, geomorphology, environmental studies, hydrology, oceanography and flood mapping.

10. Commissioned in 1989, Pakistan's satellite ground station at Islamabad acquires and processes data from three different remote sensing Earth observation satellite systems. The station was upgraded and modernized in 1998 with state-of-the-art hardware and software to acquire and process data from the new generation of remote sensing satellites. This has led to significantly improved throughput capacity, generation of data products in new media and archiving of data in more compact media.

11. Under the atmospheric research programme, automatic picture transmission (APT) images and Television Infrared Observation Satellite (TIROS) Operational Vertical Sounder (TOVS) data from the satellite of the National Oceanic and Atmospheric Administration of the

United States of America as well as supporting data are used for various atmospheric, meteorological and environmental studies.

V. Assessment of the programme

12. Pakistan possesses a reasonably well developed infrastructure for pursuing a comprehensive space research and application programme. It is expected that the space programme will diversify further, enter still more sophisticated fields and move closer to operational use of space technology in applications such as resource mapping, environmental management, disaster preparedness and mitigation; search and rescue of vessels and people in distress; more accurate navigation and position determination; networking of databases; and development of materials in microgravity conditions.

VI. Future programme

13. The main goal of the space programme is to provide operational space services to the nation. The focus is on satellite communications and remote sensing of natural resources. Those services are sought to be achieved through the indigenous development of operational spacecraft and satellite launch vehicles. It is planned eventually and on a local basis to design, develop, test and qualify operational satellites with high reliability and long life. The national space programme is poised to make substantial progress, in the next few years, for the socio-economic development of the country.

14. Pakistan has thus made steady and notable progress towards the development of technological capability in the high-tech fields of space science and technology. That policy will be continued until the attainment of self-reliance in those fields. The future of the space programme in Pakistan is thus full of promise.

VII. Vital international issues

15. Several international issues have been the concern of various nations. Major impediments to obtaining and expanding space application programmes in Pakistan are:

- (a) Lack of awareness at the decision-making level;
- (b) Lack of awareness of the benefits of appropriate space technology applications on the part of users;
- (c) Non-availability of trained technical manpower;
- (d) High initial costs of space technology hardware;
- (e) High development and maintenance costs of space systems;
- (f) Limited involvement of the private sector and industry in space technology applications, with space activities funded mainly by the Government and the public sector;
- (g) Non-standardized data, hardware, software and analytical tools, in particular with regard to remote sensing systems;
- (h) Reluctance to transfer technology and know-how to developing countries.

16. Pakistan's view is that one of the ways to promote the peaceful uses of outer space is for more countries to be afforded opportunities to interact with the "space-faring" nations by

participation in collaborative programmes in the applications of space science and space technology to utilize the benefits derived from those applications. To attain that objective, creation of an indigenous capacity in the countries, especially in the developing countries, should be considered on a priority basis.

17. Pakistan maintains that, in accordance with the Principles Relating to Remote Sensing of the Earth from Outer Space, adopted by the General Assembly, the availability of remote sensing data should not be withheld from particular countries based upon their political status, since all space-related activities should be conducted for the benefit and in the interest of all countries.

18. Pakistan is of the view that space-faring States that are responsible for launch activities should adopt and enforce tougher guidelines regarding space debris mitigation in order to prevent the cost of space activities from increasing beyond the means of developing countries.

19. Pakistan maintains that the definition and delimitation of outer space is necessary to guard against unhindered national airspace violations of any State's skies. Pakistan also believes in equitable access by all States to the geostationary orbit, taking into account the special interests and existing limitations of the developing countries.
